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Fischer, G.
Dehning, K., Dia, A., Füssel, J., Hefter, J., Iversen, M., Klann, M.,
Nowald, N., Olbrich, M., Ruhland, G.

Report and preliminary results of RV POSEIDON cruise POS464

Las Palmas (Canary Islands) – Las Palmas (Canary Islands)
03.02.2014 – 18.02.2014

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2014

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1 Participants

Name	Discipline	Institution
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Klann, Marco	Technician	MARUM
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Ruhland, Götz	Technician	MARUM

MARUM	Center for Marine Environmental Sciences, University of Bremen, Germany
GeoB	Geosciences Department, University of Bremen, Germany
AWI	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany
MPI	Max Planck Institute for marine microbiology, Bremen, Germany
THB	Technical Highschool in Bremerhaven, Marine Techology, Germany
IMROP	Institut Mauritanien de Recherches Océanographiques et des Pêches, Nouadhibou, Mauritania

2 Narrative of the Cruise

(Gerhard Fischer)

RV Poseidon left the port of Las Palmas, Gran Canaria, Spain, on February 3rd, 2014 at 9:30 pm on schedule, heading in southwesterly direction to the study area off Cape Blanc, Mauritania (Fig. 2.1).

During the cruise, we planned to perform optical, microbial, biological and geochemical studies in the water column as well as the exchange of two sediment trap moorings off Cape Blanc (CB and CBi). Both moorings were planned as long-term study sites in an important coastal upwelling filament ('giant Cape Blanc filament', Van Camp et al., 1991, Fig. 2.2) being part of the Canary Current System. The latter is one of the four major Eastern Boundary Upwelling Ecosystems characterized by strong productivity gradients and high fish stocks. CB is a mesotrophic time series site and has been started in 1988 (with one interruption), CBi as a eutrophic site and monitors particle flux in high temporal resolution since 2003. Both mooring arrays were deployed during RV POS 445 cruise in January 2013.

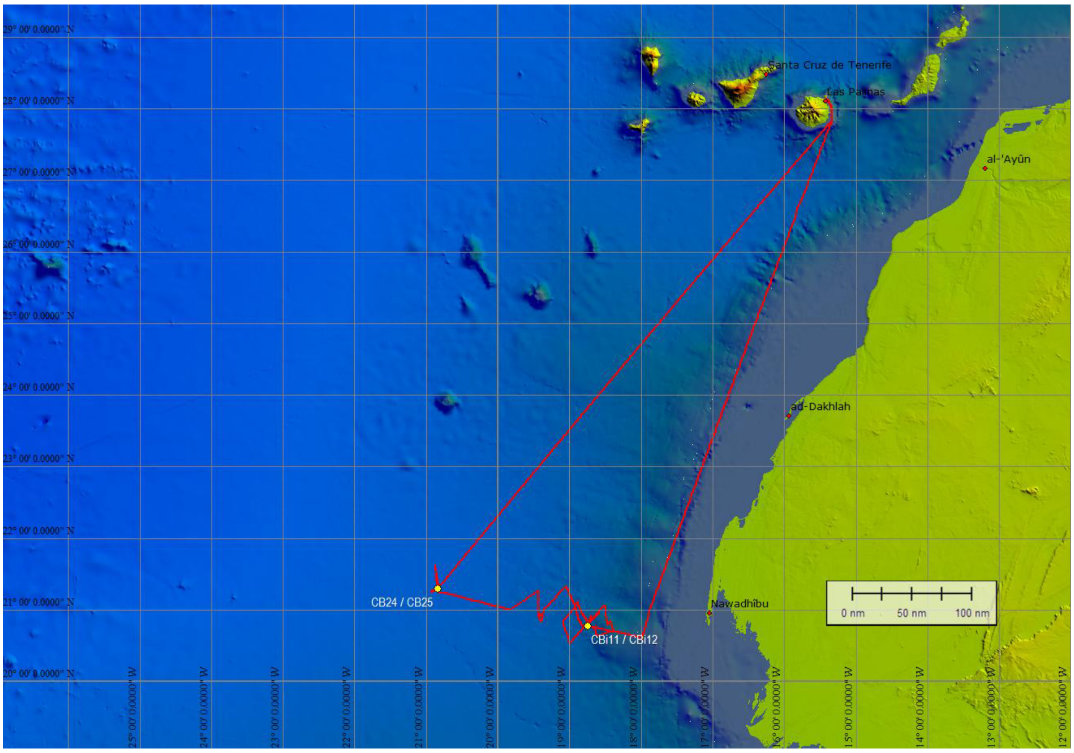


Fig. 2.1 Track of RV Poseidon cruise 464 (Las Palmas – Las Palmas, 3.2. - 19.2.2014) with the two long-term mooring sites CB (mesotrophic) and CBi (eutrophic). The tracks of the four drifting arrays were only a few miles and cannot be shown on this scale.

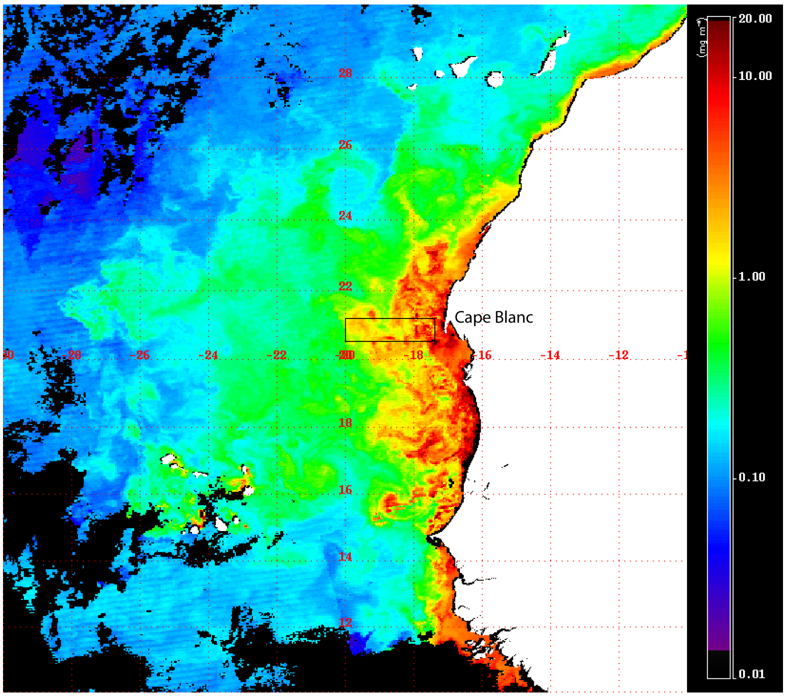


Fig. 2.2 MODIS-Satellite chlorophyll (in mg m-3) in late winter (January 2013, weekly composite: 8.1.- 16.1.2013) showing overall very high chlorophyll off NW Africa and the large seaward extension of the Cape Blanc filament dissolving further offshore into eddy systems (http://oceancolor.gsfc.nasa.gov/cgi/l3). The working box off Cape Blanc, Mauritania, during Poseidon cruises is indicated.

Further, we intended to deploy 2-4 drifting arrays with cylindrical traps for 1-2 days each, combined with a newly developed camera system (Driftcam) on an E-W transect between the two long-term sediment trap mooring sites. A particle camera was planned to be launched to measure the distribution and size of marine snow aggregates and other larger particles which are important for the biological pump. For the sampling of suspended particles, we used *in situ*-pumps which collect the fine fraction of particles in larger quantities, generally scheduled overnight. To study zooplankton abundance and distribution, we used the multinet with 5 nets, if possible for day- and night hauls to consider dial vertical migration mainly of meso-zooplankton. The studies were completed by roller tank incubation experiments with artificial marine snow aggregates of which respirations rates and sinking rates were determined. For the first time, we did sampling to investigate the nitrogen cycle within marine snow aggregates. Seven scientists from the University of Bremen (MARUM and GeoB) were on board Poseidon, one scientist from the Technical Highschool in Bremerhaven and one from the MPI in Bremen. One observer from Mauritania (IMROP, Nouadhibou) joined the cruise.

In the late afternoon of February 5th, we reached the first study site about 200 nm offshore Cape Blanc where the sediment trap mooring CB-24 was successfully recovered. The upper trap had worked perfectly, the lower trap sampled only one bulk sample from the entire sampling period. We then sampled the water column twice with the rosette-CTD (SBE-5) and launched four *in situ*-pumps down to 1000 m. Furthermore, the particle camera ParCa was launched down to 450 m. As a test instrument, the newly developed high resolution particle camera (Driftcam) was attached below the ParCa. The next morning of February 6th, the first drifting array named DF-7 was deployed, containing three sediment traps (150, 200, 400 m), each having four cylindrical cups. One of the cups of each trap was filled with a special gel to preserve fresh marine snow aggregates and pellets. For the first time, we installed the Driftcam in the drifting array in 100 m water depth as well. After launching the multinet to sample and study meso-zooplankton in five depths levels, the 3500 m long mooring array CB-25 equipped with two sediment traps was redeployed at the former position. In the evening, we deployed the multinet and the particle camera (ParCa) to study zooplankton and particle distribution at night-time.

In the next morning, we searched for the drifting array DF-7. Before recovery, we sampled the water column with the ParCa-CTD and the rosette-CTD in the vicinity of the array. We then sailed about 50 nm to the east for a short water sampling site with rosette-CTD and the ParCa-CTD. We continued our track further to the east for about 20 nm and started water column studies using the ParCa-CTD, the rosette-CTD and the multinet. In the early afternoon of February 8th, we deployed the second drifting array DF-8, followed by a rosette-CTD down to 1000 m water depth. We then did the night haul with the multinet, the ParCa-CTD and the overnight deployment of the *in situ*-pumps in four depths levels.

In the early Sunday of February 9th, we launched the ParCa-CTD system, the rosette-CTD and the Secchi disk. Around mid-day, we could recover the nearby drifting array DF-8. We continued to sail further to the east to the eutrophic sediment trap mooring site CBi-11. After the deployment of the new Driftcam for three hours in 120 m water depth in the early Monday morning, February 10th, we successfully recovered the long-term mooring array CBi-11 which provided us with two complete sample sets of sinking particles. We had installed the array with a Multi-Sensor Platform (MSP) and two sediment traps during POS cruise 445 in January-February 2013. The MSP with a CTD and a video camera system should monitor particle size classes and concentrations over an annual cycle. We deployed the rosette-CTD and the ParCa system for particle studies later during daytime, followed by deployments in the early night of Monday, February 10th. During night, the *in situ*-pumps were utilized to sample suspended particles for six hours in four water depth levels.

In the early morning of Tuesday, February 11th, we recovered the *in situ*-pumps and sampled the upper water column down to 1000 m water depth with the rosette-CTD. After deploying the third drifting array DF-9 in the early afternoon, we sailed about 20 nm to the east to a study site in ca. 1500 m water depth. We launched the rosette-CTD, two hand nets down to 50 m for collecting zooplankton and the ParCa-CTD down to 1000 m.

During night, we sailed back to the eutrophic mooring site CBi-11 where we could recover the drifting array DF-9 in the morning, even without getting a time-near satellite position due to a failure of the satellite unit. The array had drifted for about 2 nm to the south. Later, the ParCa-CTD and the rosette-CTD were deployed down to 1000 m. We sailed about 20nm to the west to work on another study site on the transect (ca. 3700 m). We used the rosette-CTD, the hand net and the ParCa-CTD.

After returning to the eutrophic mooring site CBi-11, we deployed the new long-term mooring array CBi-12 together with the MSP and too sediment traps in the early morning of February 13th. We could observe a Saharan dust outbreak lasting for approx. 2 days. Later during the day, we deployed the multinet and then continued our transect to the east sailing for about 45 nm. In the late afternoon, we deployed our Driftcam in 120 m water depths for overnight recordings (12 hours) of particle distribution and size.

In the early morning of February 14th, we used the rosette-CTD for the collection of water for primary production estimations on the path of the drifting array DF-10. We launched the ParCa-CTD and the multinet before the deployment of the drifting traps and Driftcam around lunchtime. As the satellite unit normally mounted on top of the DF-10 array had failed, we needed to follow the drifting path of DF-10 with the ship for a few hours in southerly direction (about 2 nm). During the ship's drift, we deployed the Secchi disk. In the evening of February 14th, we recovered the drifting array after roughly 7 hours of deployment. We did the night studies of the water column with the multinet, the hand net and used the ParCa-CTD twice, followed by the *in situ*-pumps which were installed overnight. After recovery of the *in situ*-pumps in the early morning of February 15th, we started our cruise back to Las Palmas. We reached Las Palmas after partly rough weather conditions in the early afternoon of February 18th.

Generally, weather conditions were not optimal during the entire cruise and we had winds mostly between 6 and 8 on the Beaufort scale. Despite these unfavourable conditions, we worked on 11 stations on a E-W transect off Cape Blanc, deploying and recovering two long-term moorings and four drifting arrays. The other deployments were: multinet (6x), hand net (4x), Secchi disk (5x), ParCa-CTD (17x), rosette-CTD (13x) and the *in situ*-pumps (4x overnight), in total 65 deployments (see station list). We could fulfil more than we had expected and had a very successful cruise.

3 Preliminary Results

3.1 Marine Microbiology

3.1.1 Nitrogen cycling in marine snow aggregates

(Jessika Füssel and Morten Iversen)

Background

Microbially mediated redox processes of the marine nitrogen cycle constitute major energy conserving pathways in the ocean and influence the availability of fixed nitrogen in the surface ocean. While the anaerobic processes of the nitrogen cycle are supposedly limited to oxygen depleted oceanic environments, such as Oxygen Minimum Zones (OMZs), sinking marine aggregates might provide oxygen reduced microniches and, thus, facilitate the occurrence of e.g. nitrate reduction, anammox or denitrification within the oxygenated ocean (Fig. 3.1). Moreover, aggregates are hot spots of organic matter degradation and are enriched in nutrients such as ammonia and nitrite. Thus, marine aggregates might harbour highly active nitrifying communities. So far, very little is known about the importance of aggregates in the marine nitrogen cycle or about the microorganisms involved.

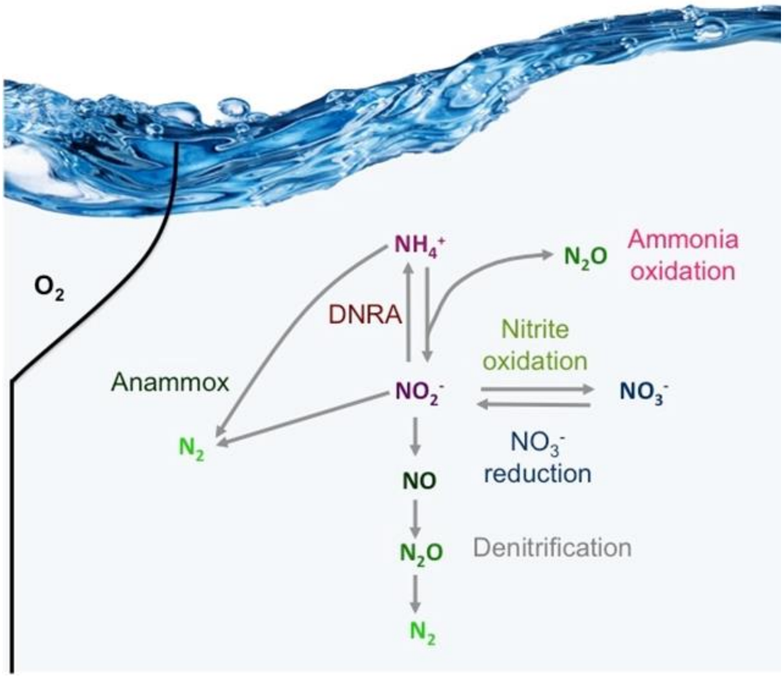


Fig. 3.1 Oxygen Minimum Zones (OMZs) are supposedly the only environments in the pelagic ocean allowing for the co-occurrence of aerobic and anaerobic N-cycling processes. These processes include ammonia and nitrite oxidation as well as nitrate reduction and DNRA. Alternatively, nitrite is reduced via anammox or denitrification, resulting in N_2-production and N-loss. Sinking marine aggregates might provide suboxic to anoxic microniches under elevated oxygen concentrations in the surrounding water and thus facilitate the occurrence of N-loss in oceanic environments that have so far been neglected as areas of nitrogen loss.

Sampling

This study aims to investigate nitrogen cycling processes occurring in marine aggregates from the highly productive Mauritanian upwelling system, where an OMZ forms at mid-water depths (100-800 m). Here, oxygen concentrations can drop to ~40 µM and large marine aggregates might provide suboxic to anoxic microniches. We either obtained aggregates from the depth of the fluorescence maximum, where seawater was obtained with Niskin bottles attached to a CTD rosette and incubated in roller tanks to allow for the re-aggregation of POM (GeoB stations 18007-1, 18004-5, 18006-9, 18011-6). Subsequently, we measured size, sinking velocity and O_2 fluxes to the aggregates using O_2-microsensors and a flow system for sinking velocity measurements. Single aggregates were incubated in sterile filtered seawater that had been amended with ^{15}N labeled inorganic nitrogen compounds to measure rates of ammonia and nitrite oxidation, nitrate reduction, anammox and denitrification (Table 3.1). The aggregates were incubated for up to 48 h and biological activity was stopped by the addition of mercuric chloride. Rate measurements were conducted on an isotopic ratio mass spectrometer (IRMS) in the home laboratory.

To investigate the diversity and abundance of N-cycling microorganisms, single aggregates were fixed in 2% PFA overnight, destroyed and filtered onto polycarbonate filters (pore size: 0.2 µm). Catalyzed-amplified-reporter-deposition *in situ*-fluorescence hybridization (CARD FISH) with specific probes targeting groups of N-cycling microorganisms will be conducted in a land based laboratory.

Table 3.1 ^{15}N incubation experiments conducted to measure rates of N-cycling. Prior to the analyses for the targeted products listed, $^{15}N^{15}N$:$^{14}N^{14}N$ and $^{14}N^{15}N$:$^{14}N^{14}N$ ratios of the produced N_2 were determined in all treatments in order to measure denitrification and anammox rates.

^{15}N-cylce process	$^{15}NH_4^+$ [µM]	$^{15}NO_2^-$ [µM]	$^{15}NO_3^-$ [µM]	$^{14}NO_2^-$ [µM]	$^{14}NH_4^+$ [µM]	targeted ^{15}N product
NO_2^- oxidation/Denitrification		2.5				$^{15}NO_3^-$
NH_4^+ oxidation/Anammox	2.5			2.5		$^{15}NO_2^-$
NO_3^- reduction			15	2.5		$^{15}NO_2^-$
DNRA		2.5			2.5	$^{15}NH_4^+$

3.2 Marine Zoology

3.2.1 Mesozooplankton collected with the multinet and the hand net

(Morten Iversen, Marco Klann and Gerhard Fischer)

We used a multiple net from HYROBIOS, Kiel, fitted with five nets of 200 µm mesh size to sample meso-zooplankton in various depth ranges from the water column in the Cape Blanc area and used standard collection depths of 1000-600, 600-300, 300-150, 150-80 and 80-0 m (Table 3.2). We planned to perform day-and-night hauls to account for dial vertical migration of the various species and all together six hauls were done. Together with plenty of hauls during other Poseidon cruises POS 425, 445), we plan to investigate the importance of zooplankton (e.g. copepods, euphausiids, appendicularia) for particle degradation in the upper water column, mainly in the epi- and mesopelagic. Day-and-night profiles were done to determine which species excert vertical diel migration. The collected samples were fixed with formaldehyde and stored cold (4°C) during the cruise.

Table 3.2 Samples taken with the multiple plankton net (multinet, MN) equipped with nets of 200 µm mesh size. Standard sampling depths with the five nets were: 1) 1000-600, 2) 600-300, 3) 300-150, 4) 150-80 and 5) 80-0 m. At the last site GeoB18011-9 with a day and night haul, the first/lower net 1 sampled the depth range between 700 and 600 m, while the other four nets each sampled the standard depths ranges as indicated above.

Station No. GeoB-No.	Date 2014	Time MN at depth UTC	Latitude N	Longitude W	Water depths m	Remarks
18001-11	06.02	21:15	20°46.59’	18°44.32’	2736	Standard
18004-3	08.02	10:19	20°55.01’	19°25.01’	3454	Standard
18004-7	08.02	19:47	20°55.02’	19°25.02’	3475	Standard
18010-1	13.02	11:04	20°46.59’	18°44.32’	2736	Standard
18011-5	14.02.	11:16	20°37.01’	17°59.33’	747	700-600 (net 1)
18011-9	14.02.	20:21	20°35.07’	17°59.59’	753	700-600 (net 1)

In addition to the multinet hauls, we made two vertical hand net hauls at two stations: GeoB18009-1 and GeoB18011-10. The two vertical hand net hauls were made from 50 m to the surface with a plankton hand net of 75 µm mesh size. The hand nets were made after sunset in order to have as many zooplankton organisms in the surface waters as possible. The zooplankton collected with the hand nets were incubated in roller tanks together with marine snow aggregates and video recordings were made with illumination from infrared light. These incubations were made to attempt to capture the feeding behavior of different zooplankton species on marine snow. Several hours of random video recordings were made during the cruise, however, no analysis of the recordings has been performed up to now.

3.3 Organic Biogeochemistry

3.3.1 Composition, alteration, lateral transport and sources of particulate organic matter

(Jens Hefter)

Organic matter compositions from sediment traps as well as core tops document relations and interactions between marine production, particulate organic matter (POM) flux and composition and final burial in sediments. Recent studies emphasize that lateral transport (advection) and alteration/degradation of POM during sinking in the water column have an additional strong imprint on the POM flux and composition. Results from POM samples of the study area, taken in previous years during several expeditions (MSM 11-2 / 2009, POS 396 / 2010, MSM 18-1 / 2011, POS 425 / 2012, POS 445 / 2013), have indicated significant variations in the composition and abundance of lipid biomarkers and Intact Polar Lipids (IPL´s) throughout the water-column.

To complement and confirm these previous results, POM-samples from different water depths were collected during this cruise at four stations. Large volumes of water samples (up to ca. 1200 l, Table 3.3) were filtered with four *in-situ* pumps (ISP, McLane Large Volume Water Transfer System, WTS-LV-4/-8) on 142 mm, 0.4µm GF/F filters (Fig. 3.2).

Table 3.3 Samples taken with in-situ pumps (ISP), GFF filter 0.4µ.

GeoB #	Date 2014	Lat (N)	Long (W)	water depth (m)	sample depth (m)	water volume (l)	runtime (hh:mm)	in situ T (°C)[1]
18001-5	05/06.02	21°17,87'	20°49,98'	4167	30	790.04	05:35	19.6
18001-5	05/06.02	21°17,87'	20°49,98'	4167	150	1176.97	05:35	16.1
18001-5	05/06.02	21°17,87'	20°49,98'	4167	400	1126.82	05:35	12.4
18001-5	05/06.02	21°17,87'	20°49,98'	4167	1000	1126.82	05:35	6.7
18004-9	08/09.02	20°54,98'	19°24,97'	3459	40	602.6	05:45	18.8
18004-9	08/09.02	20°54,98'	19°24,97'	3459	150	973.96	05:45	16.6
18004-9	08/09.02	20°54,98'	19°24,97'	3459	400	1160.4	05:45	12.4
18004-9	08/09.02	20°54,98'	19°24,97'	3459	1000	1160.4	05:45	6.8 (940)
18006-7	10/11.02	20°48,12'	18°44.59'	2709	30	647,53	06:00	17.2
18006-7	10/11.02	20°48,12'	18°44.59'	2709	150	1063.77	06:00	15.0
18006-7	10/11.02	20°48,12'	18°44.59'	2709	400	1210.85	06:00	11.5
18006-7	10/11.02	20°48,12'	18°44.59'	2709	1000	1210.86	06:00	6.4 (990)
18011-13	14/15.02	20°35,05'	17°59,37'	748	30	589.82	06:00	16.8
18011-13	14/15.02	20°35,05'	17°59,37'	748	100	732.6	06:00	15.4
18011-13	14/15.02	20°35,05'	17°59,37'	748	200	382.89	01:54	14.2
18011-13	14/15.02	20°35,05'	17°59,37'	748	400	1206.58	05:58	10.8

[1]CTD data, number in brackets = closest CTD depth, when sample depth not available

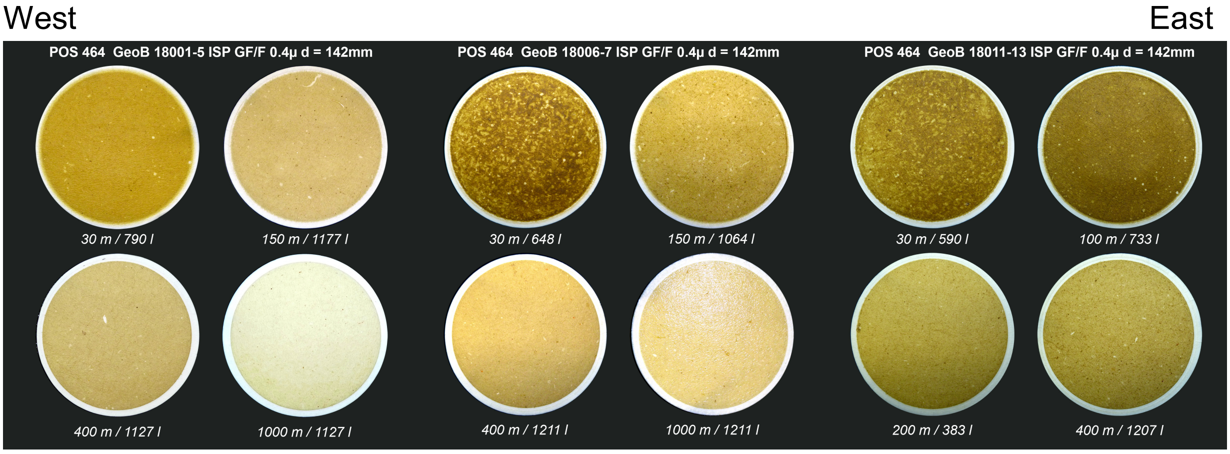


Fig. 3.2 POM abundance and appearance obtained on the filters of the *in situ*-pumps (ISP) at three main sites (CB, CBi, Cape Blanc Slope, from left to right = W to E). Water depths and filtered water volumes are indicated below each filter.

Supplementary surface water samples (5 m, Table 3.4) from various day- and night-times were obtained using the ship´s seawater inlet system and filtration on 142 mm / 0.4 µm GF/F filters.

Table 3.4 POM surface water samples from 5 m water depth.

Station GeoB	Date 2014	Time	Lat. (N)	Lon. (W)	volume (l)	SST (°C)
GeoB18001	05.02	16:10	21°17.01'	20°50.09'	71	19.6
GeoB18002-3	07.02	9:35	21°14.21'	20°48.12'	134	19.8
Transit	07.02	14:45	21°8.33' - 21°6.60'	20°21.76' - 20°15.09'	150	19.2
GeoB18003-1	07.02	19:10	20°59.98'	19°50.01'	121	19.2
GeoB18004-2	08.02	8:55	20°54.99'	19°25.00'	121	18.7
GeoB18004-3	08.02	11:20	20°55.00'	19°25.00'	127	18.8
GeoB18004-8	08.02	20:00	20°54.99'	19°24.99'	112	18.8
GeoB18004-9	08.02	23:15	20°55.07'	19°25.01'	98	18.7
GeoB18006-2	10.02	10:00	20°46.44'	18°44.37'	96	17.2
GeoB18006-4	10.02	13:25	20°48.05'	18°44.49'	88	17.1
GeoB18006-7	10.02	22:45	20°48.18'	18°44.54'	66	17.2
GeoB18009-1	12.02	20:30	20°50.78'	19°05.04'	58	18.7
Transit	13.02	14:45	20°42.16' - 20°40.56'	18°23.75' - 18°16.19'	67	17.4
GeoB18011-3	14.02	7:50	20°37.01'	17°59.35'	70	16.8
GeoB18011-6	14.02	11:20	20°37.23' - 20°36.82'	17°59.54' - 17°59.19'	83.5	16.3 - 16.8
GeoB18011-8	14.02	18:30	20°35.06'	17°59.54'	86	17.2

All filters were stored frozen (-20 °C) on board immediately after recovery and transported frozen to the home laboratory for future analyses. These will include organic matter / lipid extraction, separation of distinct compound classes (e.g. fatty acids, archaebacterial GDGT´s, intact polar lipids / IPL´s, etc.) and compound identification / quantification by using gas chromatography (GC), gas chromatography / mass spectrometry (GC/MS) as well as liquid chromategraphy / mass spectrometry (HPLC/MS).

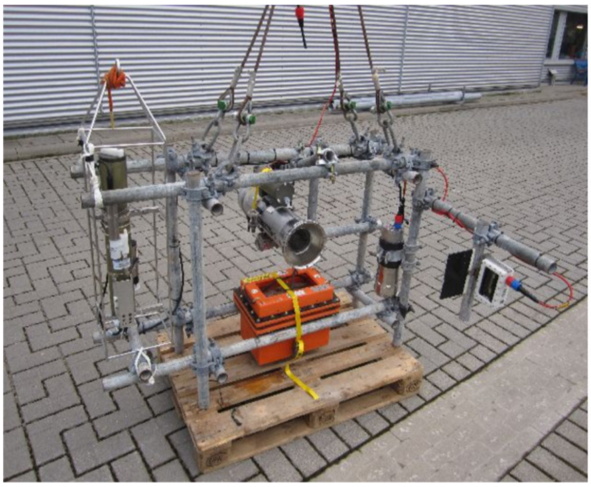
3.4 Optical studies

3.4.1 *In situ* particle properties acquired with ParCa-Pro

(N. Nowald)

System description

ParCa-Pro is a profiling, digital still image camera system designed to acquire the vertical distribution of organic particles in the ocean down to 4000 m water depth. The system consists of the camera itself, a strobe electronics pod that provides power for the strobe-head, a 24 V/ 38 Ah rechargable deep-sea battery and a Seabird SBE19-CTD (with chl fluorescence, oxygen and turbidity sensors) (Fig. 3.3). All components are mounted to a galvanized frame with a total weight of around 250 kg. The still camera itself consists of a Photosea 60 mm middle format camera combined with a Kodak ProBack digitalization device (16 Megapixel resolution). The strobe-head is mounted perpendicular to the optical axis of the camera and creates a slab of light of 12 cm width, illuminating a sample volume of 11.6 liters. The ParCa microcontroller and a Seabird SBE 36 telemetry unit, provide full control over the system via the ships coaxial wire. The microcontroller receives the CTD´s pressure data and triggers the camera automatically according to depth intervals entered in



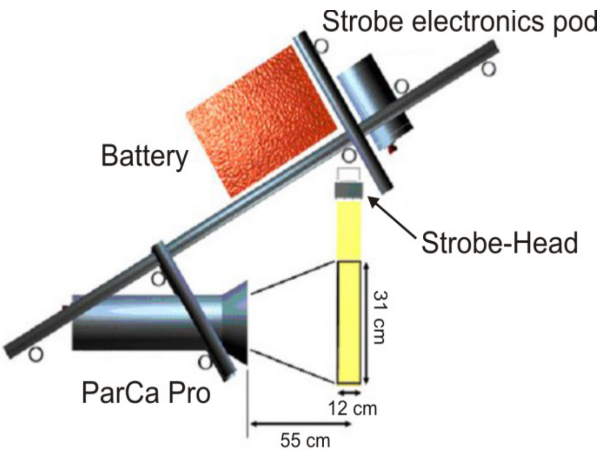


Fig. 3.3 ParCa-Pro with CTD (left part of camera frame) at MARUM-Bremen facility (left panel) and schematic drawing of the system and its components (right panel).

the GUI. Upon recovery, the images are downloaded from the camera to a PC for analysis and data extraction. During RV Poseidon expedition 464, the focus of particle studies was in the upper ocean layers and the camera collected images during 14 deployments down to 1000 m water depth. A detailed station list is given in Table 3.5.

Table 3.5 List of ParCa stations, with CTD-chl-fluorescence-oxygen-turbidity sensors.

Station GeoB#	Date 2014	Lat (N)	Lon (W)	Depth (m)	Profiling depth (m)	Interval (m)	Deploy time	Recovery
18001-4	05.02.	21°17.88	20°49.69	4120	440	5	20:53:00	21:30:00
18001-10	06.02.	21°17.19	20°51.22	4214	500	5	19:50:00	20:30:00
18002-1	07.02.	21°14.34	20°48.31	4173	120	5	08:30:00	09:00:00
18003-2	07.02.	20°59.99	19°50.00	3786	500	5	20:00:00	20:35:00
18004-1	08.02.	20°55.02	19°25.05	3794	500	5	08:00:00	08:30:00
18004-8	08.02.	20°55.00	19°24.99	3459	500	5	20:45:00	21:15:00
18005-1	09.02.	20°55.95	19°25.52	3473	500	5	08:00:00	08:45:00
18006-5	10.02.	20°48.05	18°44.43	2713	970	5	14:15:00	15:30:00
18006-6	10.02.	20°48.09	18°44.57	2711	962	7	21:00:00	21:50:00
18007-4	11.02.	20°42.52	18°23.09	1547	962	7	21:30:00	22:20:00
18008-2	12.02.	20°45.90	18°47.54	2864	976	7	09:45:00	10:45:00
18009-4	12.02.	20°50.96	19°05.02	3254	171	7	22:00:00	22:20:00
18011-4	14.02.	20°37.02	17°59.35	750	700	7	07:20:00	08:45:00
18011-12	14.02.	20°35.05	17°59.57	749	710	7	21:05:00	22:30:00

Preliminary Results

A total of 14 vertical profiles were acquired at 7 sites along a West-East transect in the working area off Cape Blanc. Short profiles down to a maximum of 1000 m water depth were acquired in order investigate changes in the abundance of particles during day and night time in surface, subsurface and intermediate water masses. Day and night concentration profiles were also acquired at the deployment and recovery positions of the free drifting traps. A selection of camera profiles from stations at different water depths in the study area is shown in Figure 3.4. In general, particle abundance decreased with increasing distance from the coast, as a result of decreasing chorophyll standing stocks and primary production in offshore direction. The particle concentrations in the first 100 m of the water column were several orders of magnitude higher compared to the depths below. Distinct changes in the particle concentrations between day and night were not observed at first glance. However, the profiles require a more detailed analysis onshore, because the data shown here were generated by using a simplified image analysis to get results shortly after recovery for further particle studies and sampling strategies. When following the particle concentrations from East to West, one trend is clearly visible. Particle abundances decrease with increasing depth at stations close to the coast (700 m and 2800 m station), remain more or less constant at the 3500 m station and increase with depth at the deeper CB location offshore. Remineralisation of organic particles may be higher at shallower depths closer to the coast, while the regions further offshore are influenced by the input of laterally transported material from the coast to the open ocean via deeper water layers.

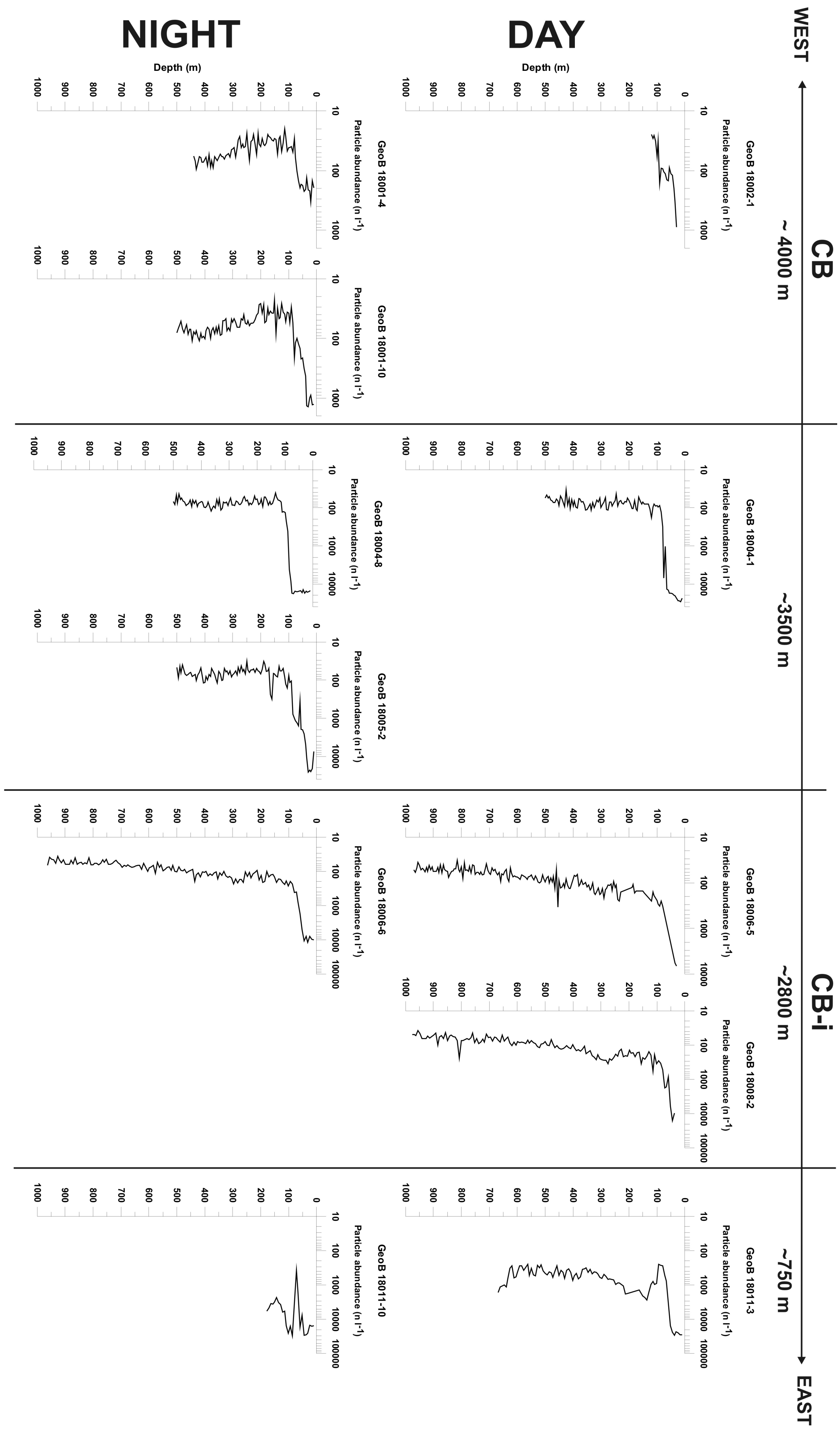


Fig. 3.4 Day and night concentration profiles acquired along a West-East transect off Cape Blanc. Note the logarithmic scaling of the particle abundances and the higher abundances of particles at the more coastal sites.

3.4.2 Particle studies with the Driftcam

(N. Nowald and M. Olbrich)

A particle camera newly developed together with the Technical Highschool in Bremerhaven, the Driftcam, was planned as an additional device for the drifting arrays which were used since several years for particle sedimentation studies off Cape Blanc. The drifting arrays generally consist of three traps, which collect sinking particles at different water depths, generally 100, 200 and 400 m (see also Chapter 3.6.1). During this cruise, simultaneous data of *in situ* particle parameters, such as size or abundance, were gathered with this instrument which are important to understand particle transformation processes and flux attenuation in the upper ocean surface. Apart from being used inside the free drifting mooring array, the camera was also launched for short (hours) time series deployments. The camera was then lowered at a specific depth with the ships winch and left there for several hours were it would acquire images at rather short time intervals. A station list for this instrument with detailed deployment data is shown in Table 3.6.

Table 3.6 Station list of Driftcam deployments.

Station GeoB	Date 2014	Deployment type	Position: Start/End Lat (N)/Long (W)	Deployment depth (m)	Deployment time (h)	Exposure Interval (min)
18001-4	05.02.	Profiling	21°17.9‘/20°50‘	500	0.5	0.03
18001-7	06.02.	DF-7 array	21°15.7‘/20°49.9‘ 21°14.4‘/20°28.3‘	100	22	60
18004-2	08.02.	DF-8 array	20°55.6‘/19°25.9‘ 20°55.0/19°25.6’	150	22	60
18006-1	10.02.	Time series	20°45.8’/18°44.8’	120	3	3
18006-9	11.02.	DF-9 array	20°48.0’/18°44.5’ 20°45.7’/18°47.6’	250	19	60
18009-3	12.02.	Tests of optics	20°50.8’19°05.1’	100	0.5	1
18011-1	13.02.	Time series	20°37./17°59.3’	100	12	1
18011-6	14.02.	DF-10 array	20°37.1’/17°59.2’ 20°35.1’/17°59.6’	150	6.5	1

The system consists of commercially available components. The camera is a Canon EOS 600D DSLR (18 Megapixel resolution) with an EF 50.2 macro-lense connected to a Canon Speedlight 430 EX II flash. The camera can be easily programmed using a Delamax LCD Timer for delayed and/or interval exposures. Camera and flash are each installed in a POM pressure housing with a depth rating of 500 m. All components are mounted inside an aluminium frame and total weight of the system is 50 kg (Fig. 3.5). The optical setup is identical to ParCa-Pro, using an orthogonal arrangement of camera and flash. Particles revealed sharp pictures at about 30 cm distance from the lense and focussed in a depth range of 60 mm along the optical axis of the camera. Total sample volume is 0.5 liter.

Preliminary Results

Figure 3.5 (right panel) shows the results of a 22 h deployment of the Driftcam within the DF-7 deployment at 100 m water depth at the mesotrophic sediment trap mooring site CB. Particle abundances were around 750 n l^{-1} on average and underlie significant variations, especially before 18.00 and after midnight. The total particle volume remained more or less constant (around 3 mm^{-3} l^{-1}) but two distinct peaks were identified around 19.00 in the evening and around 7.00 in the morning at times when zooplankton strongly migrates. Due to the high resolution of the camera and the small sample volume, the camera was able to acquire considerably small particles with a minimum size of 25 µm ESD (Equivalent Spherical Diameter). This is well reflected in the average ESD showing that the majority of particles was rather small, but particle abundances were higher compared to data derived from the ParCa-Pro system.

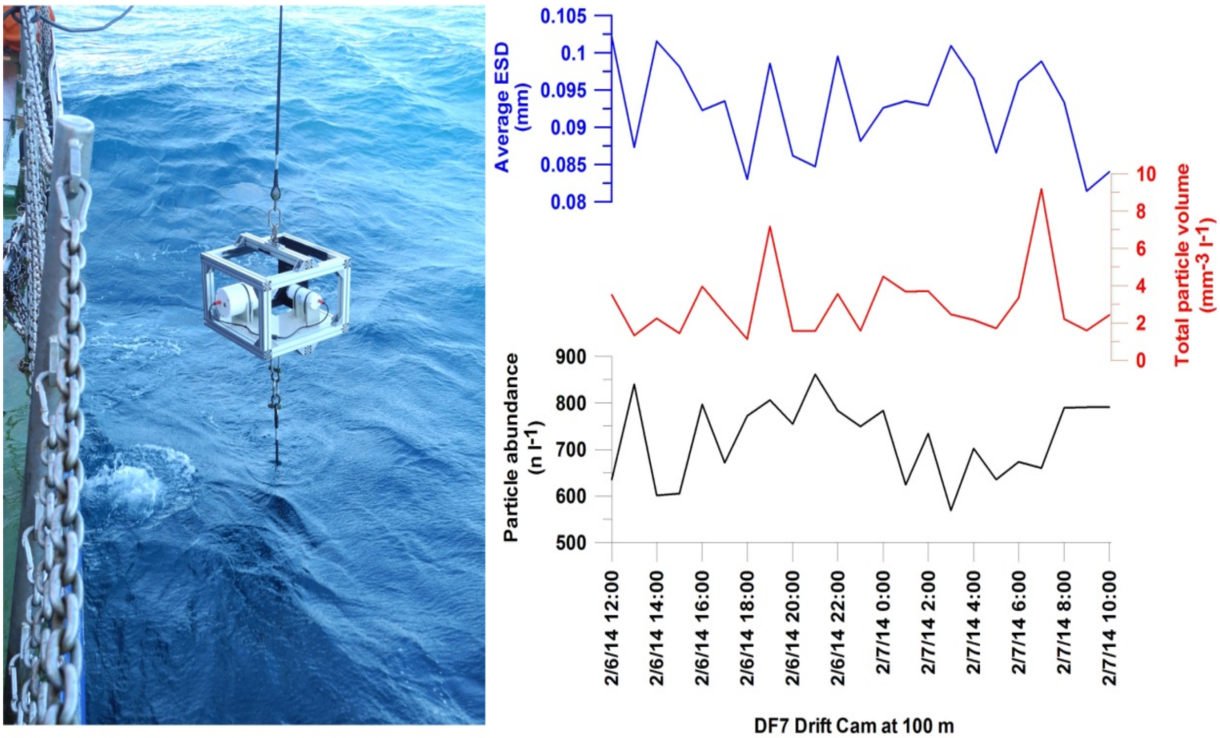


Fig. 3.5 Driftcam ready for deployment within the drift array DF-7 (left) at the eutrophic sediment trap site CBi. On the right panel, processed data of a ca. 2-day time series of particle abundance, volume and size (ESD= Equivalent Spherical Diameter) are shown. Major peaks in total particle volume occurred in the evening and early morning. Particle size (ESD) was low throughout. Deployment data see also Table 3.6.

3.4.3 Video records with the Multi-Sensor Platform (MSP)

(N. Nowald and G. Ruhland)

The MSP was part of the CBi-11 mooring and moored at a water depth around 1300 m, 50 m above the upper sediment trap (Table 3.10). The platform is a hexagonal glass fibre reinforced plastic frame with a height of 2.3 m and a diameter of 1 m. It is equipped with a Falmouth Scientific CTD with acoustic current meter and a Sony HDTV video camera for the acquisition of particle concentrations and sizes over time (Fig. 3.6). The CTD records oceanographic parameters every 6 h while the video camera records a 20 seconds video sequence every third day at midnight for one year. The system consists of the video camera, an electronic pod that controls and powers the 50 Hz flash-head and a 12V/38 Ah rechargeable DSPL battery. Between the January 29th, 2013 and February 8th, 2014, the camera recorded a total of 126 video sequences on a 60 min Mini DV tape that will be processed and analysed onshore.

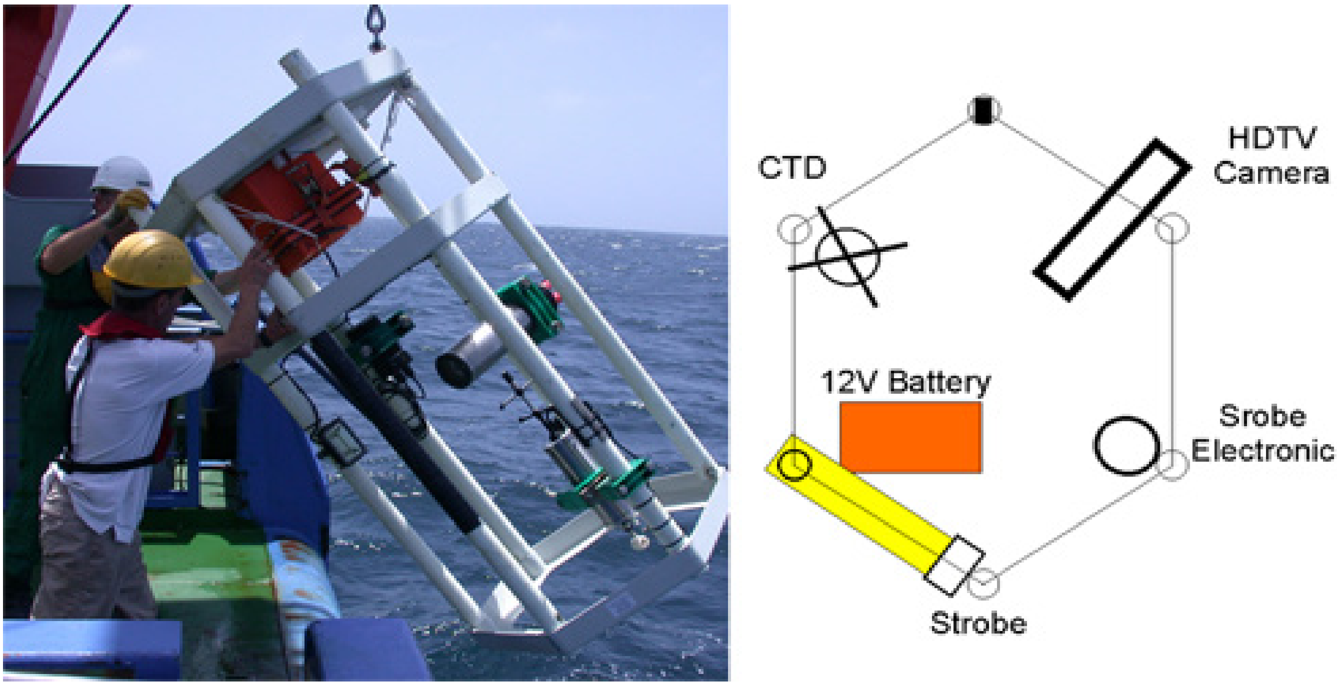


Fig. 3.6 Deployment of the Multi-Sensor Platform (MSP) during a RV Poseidon cruise (left) in an upside down position. Top view of the devices installed within the MSP is shown on the right.

3.5 Oceanography

3.5.1 CTD-O_2-chlorophyll-fluorescence-turbidity probe (SBE-19)

(Nico Nowald and Gerhard Fischer)

CTD/O_2/chlorophyll-fluorescence-turbidity profiles were taken with a self-contained SBE-19 profiler equipped with a conductivity-temperature-depth probe plus oxygen sensor, a CHELSEA-fluorometer and a WETLAPS turbidity sensor. This CTD was attached to the frame of the ParCa-Pro system (Fig. 3.4, chapter 3.4.1) and was deployed 16 times during the cruise (Table 3.7 and station list). The data were removed immediately after recovery of the system and standard downcast plots were made. This cruise we had problems occurring several times when unloading the data from the main board.

Table 3.7 List of CTD-O_2-chlorophyll-fluorescence-turbidity profiles taken with the SBE-19 profiler attached to the ParCa-Pro system (see chapter 3.4.1).

GeoB station	Date 2013	Time UTC	Lat N	Long W	Water depth m	Deployment depth/ wire length (m)
18001-4	05.02.	21:33	21°17.88	20°49.69	4120	450
18001-10	06.02.	20:10	21°17.19	20°51.22	4214	500
18002-1	07.02.	08:41	21°14.34	20°48.31	4173	158 stopped
18003-2	07.02.	20:21	20°59.99	19°50.00	3786	500
18004-1	08.02.	08:20	20°55.02	19°25.05	3794	500
18004-8	08.02.	21:01	20°55.00	19°24.99	3459	500
18005-1	09.02.	08:35	20°55.95	19°25.52	3473	500
18006-5	10.02.	14:52	20°48.05	18°44.43	2713	1000
18006-6	10.02.	21:42	20°48.09	18°44.57	2711	1000
18007-4	11.02.	22:10	20°42.52	18°23.09	1547	1000
18008-2	12.02.	10:23	20°45.90	18°47.54	2864	1000
18009-4	12.02.	22:13	20°50.96	19°05.02	3254	stopped at 250m
18011-3	14.02.	07:36	20°37.04	17°59.32	750	stopped at207m
18011-4	14.02.	08:31	20°37.02	17°59.35	750	700
18011-11	14.02.	21:27	20°35.04	17°59.49	753	stopped
18011-12	14.02.	22:16	20°35.05	17°59.57	749	710

Our major interest was on the turbidity records of the water column in the area of the continental slope of Mauritania, where particles are transported offshore into the open ocean. From previous studies, surface, intermediate, mid-water and a bottom-near particle layers were expected (e.g. Karakas et al., 2006). Generally, characteristics of larger sized particles are preferentially recorded with the ParCa-Pro system (see chapter 3.4.1), whereas the finer particle sizes should be seen with the turbidity sensor. Nevertheless, an overlap of both size classes obviously occurs, as seen by the comparison of turbidity profiles from earlier CTD deployments and the ParCa-Pro results of particle abundance. The interaction of suspended particles in certain nepheloid layers with larger sinking particles, e.g. marine snow aggregates collected with the sediment traps is still unclear. This cruise, our major focus was not on the deeper particle layers but on the upper 1000 m of the water column (see Table 3.7).

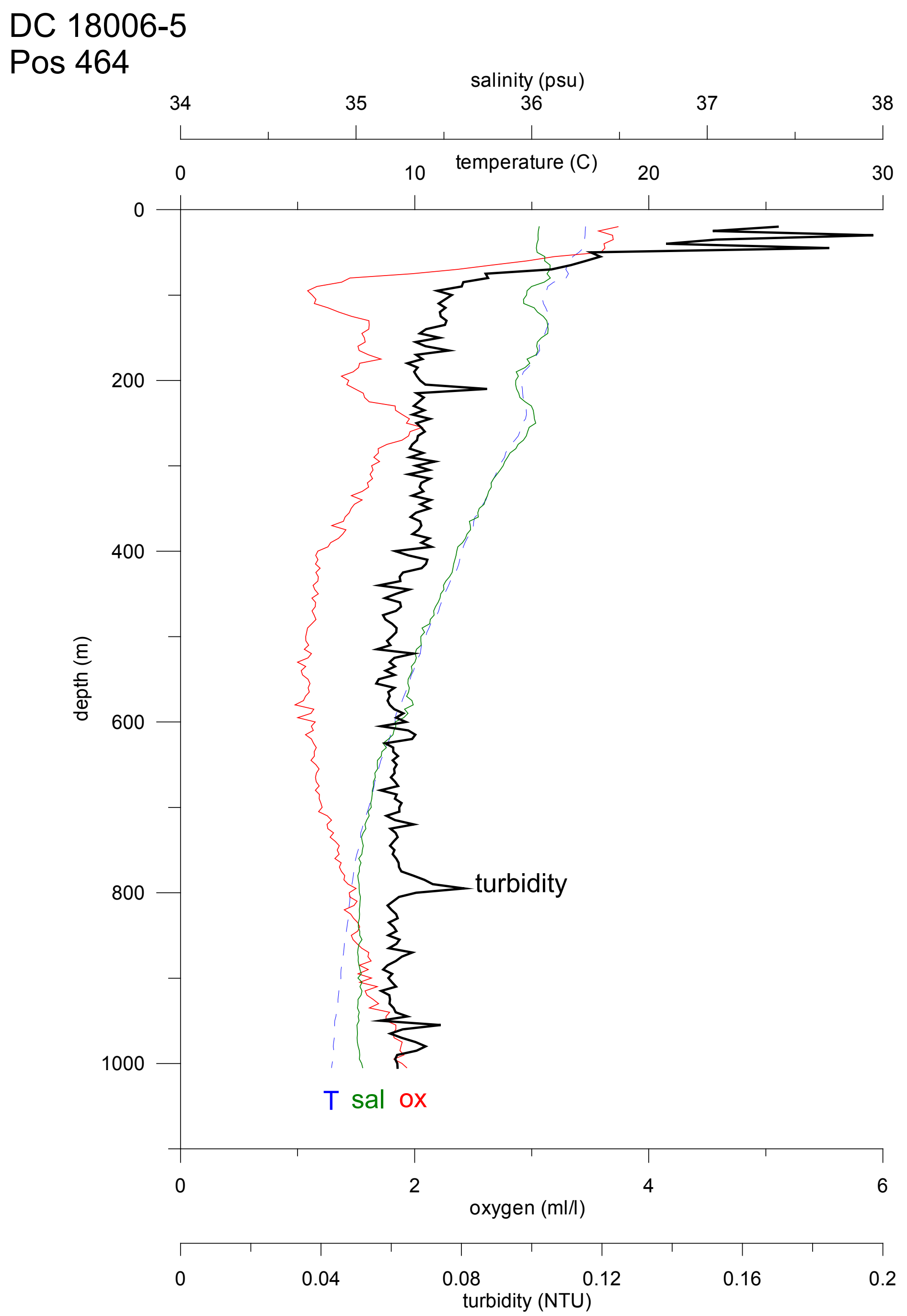


Fig. 3.7 Example of a CTD-O_2-turbidity profile from the upper 1000 m taken at the eutrophic sediment trap mooring site CBi. Absolute oxygen is too low due to alteration of the sensor membrane. Particle concentrations were highest in the upper ca. 80 and then declined strongly. Below, only some smaller spikes occurred (e.g. at 200 m, 800 m, around 1000 m) partly reflected in the ParCa profiles (Fig. 3.4, 3.4.1).

3.5.2 Rosette with CTD-O_2-chlorophyll-fluorescence- probe (SBE-5) and the Secchi disk

(Morten Iversen and Jessika Füssel)

Background

We recorded thirteen vertical profiles with the shipboard Seabird CTD (see Table 3.8). The CTD was equipped with additional oxygen and fluorescence sensors and mounted on a rosette with 12 Niskin bottles. Water samples were collected on some of the CTD-Rosette casts and used for incubations in roller tanks to form settling aggregates, for incubations with stable nitrogen isotopes to study nitrogen cycling off Cape Blanc (see this cruise report “Nitrogen cycling in marine aggregates”) as well as for primary production incubations on the drifting sediment trap array (see this cruise report “Drifting sediment traps”).

Table 3.8 List of CTD-rosette profiles and depths of water taken with Niskin bottles. Water samples were taken for studies of nitrogen cycling, aggregate formation, and primary production measurements.

Station No. GeoB	Latitude (N)	Longitude (W)	Water depth (m)	Water depths of samples (m)
18001-3	21°17.89’	20°50.07’	4172	4 x 30, 2 x 75, 2 x 130, 200, 400, 600, 1000
18001-6	21°17.89’	20°50.00’	4172	2 x 7, 2 x 14, 2 x 21, 2 x 31, 2 x 47, 2 x 100
18002-3	21°14.21’	20°48.11’	4155	4 x 30, 2 x 95, 2 x 150, 2 x 200, 2 x 400
18003-1	21°00.00’	19°50.00’	3705	No water samples taken
18004-2	20°54.98’	19°25.01’	3454	2 x 7, 14, 2 x 21, 4 x 31, 47, 75, 125
18004-6	20°54.99’	19°24.98’	3454	No water samples taken
18005-2	20°55.90’	19°25.60’	3460	4 x 100, 4 x 200, 4 x 400
18006-4	20°48.08’	18°44.46’	2721	No water samples taken
18006-8	20°48.05’	18°44.76’	2721	2 x 20, 40, 2 x 50, 60, 2 x 100, 2 x 200, 2 x 400
18007-1	20°42.06	18°23.02’	1571	10 x 50, 2 x 120
18008-3	20°46.08’	18°47.37	2823	5 x 100, 3 x 200, 4 x 400
18009-1	20°50.79’	19°05.03’	3272	No water samples taken
18011-2	20°36.99’	17°59.28	750	2 x 7, 14, 4 x 21, 31, 47, 110, 200, 400

Preliminary Results

The vertical CTD profiles were obtained along a transect in an onshore direction off Cape Blanc (Fig. 3.8). The different water layers are characterized by their temperature and salinity that result in vertical density gradients with a pycnocline between 0-300 m depth (Fig. 3.9). The cold surface water off the Mauritanian coast indicates the strong upwelling of the Canary upwelling system in this region, where the nutrient-rich deeper water fuels high chlorophyll standing stocks and high rates of primary productivity. The fluorescence profiles indicate that the highest concentration of phytoplankton was at the stations closest to the coast which coincides with the strong upwelling of nutrients at these stations. The intense subsurface respiration of the sinking organic matter results in the formation of an oxygen minimum zone (OMZ) between 200 and 500 m water depth (Fig. 3.9).

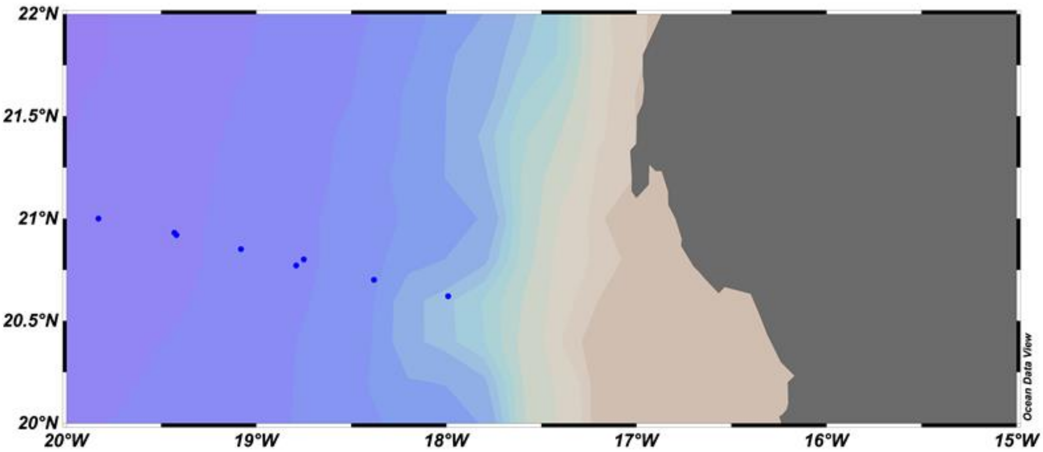


Fig. 3.8 Vertical CTD-profiles were obtained along an offshore transect off Cape Blanc, Mauritania. Blue circles indicate the sampling stations.

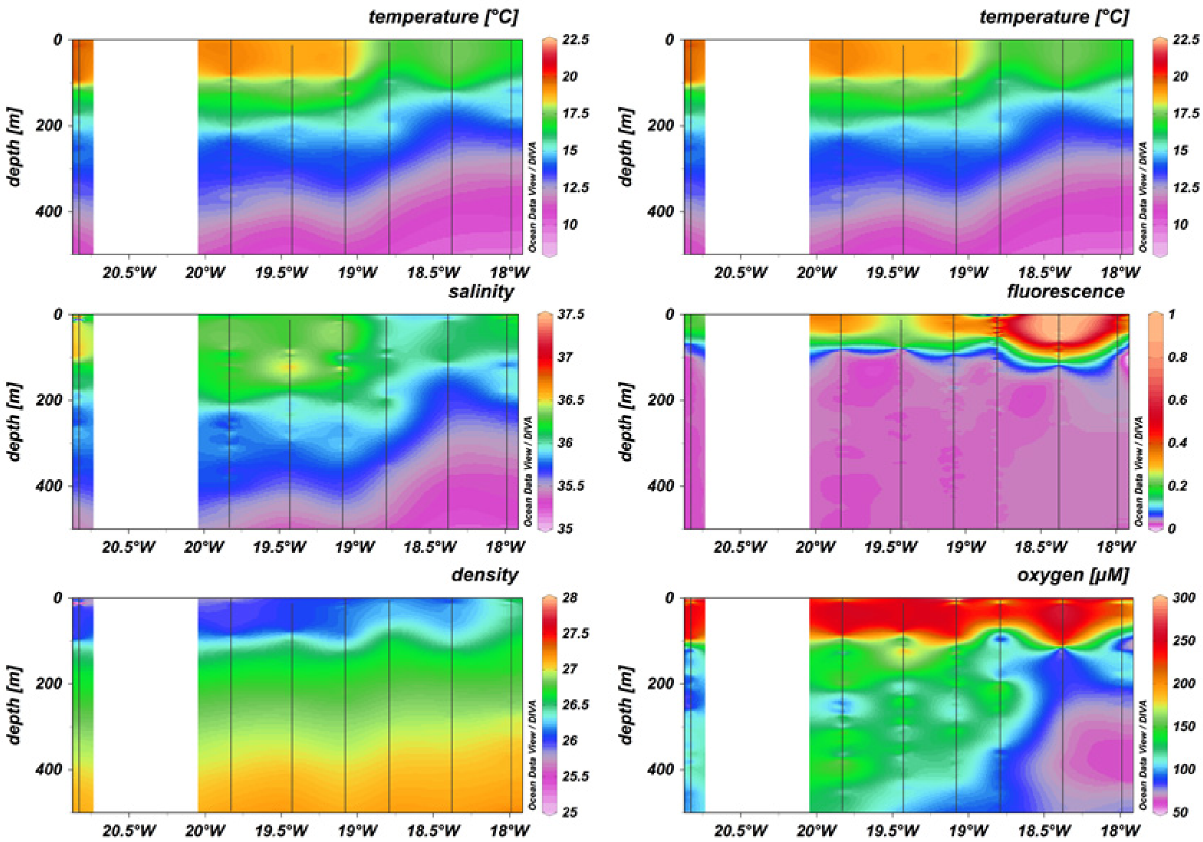


Fig. 3.9 Vertical profiles of temperature, salinity and resulting density as well as of chla fluorescence and oxygen concentrations were recorded along an offshore transect of Cape Blanc, Mauritania.

We deployed bottle incubations with carbon-13 to estimate the primary production rates during the drifting sediment trap deployments (see cruise report “Drifting sediment traps”). We used a Secchi disk to determine the light attenuation at each station where we carried out primary production incubations. Typically, the Secchi depth was around 17.5 m and we determined the depths for the primary production incubations to be at 7, 14, 21, 30, and 47 m, corresponding to light percentages of 50, 25, 12.5, 5, and 1 %.

3.6 Marine Geology

3.6.1 Upper Ocean particle flux measured with free-drifting particle traps: Marine snow in the twilight zone

(Morten Iversen, Jessika Füssel, Nicolas Nowald, Götz Ruhland, Marvin Olbrich and Marco Klann)

Background

During the cruise we were especially interested in studying the processes influencing the formation, transformation, degradation and export of sinking organic marine aggregates. Our previous work in the area off Cape Blanc, Mauritania, has shown that the decrease in the amount of organic material which sinks to the deep ocean mainly occurs in the upper few hundred meters of the water column (Nowald et al. 2006; Iversen et al., 2010). Within the past few years we have been able to identify and quantify the processes responsible for the flux attenuation, i.e. the decrease in export flux with increasing water depth (Iversen et al., 2014). Especially, the vertical migrating zooplankton seems to be able to exert extensive grazing pressure on the sinking aggregates during night. While zooplankton grazing on settling aggregates only seems to occur in the surface water during night, microbial degradation of the aggregates takes place at all depths at all times, but decreases from 13 % d^{-1} to around 4 % d^{-1} at depths below 200 m (Iversen et al., 2014; Iversen and Ploug, 2013). Though there seems to be a clear link between the presence of vertically migrating zooplankton and flux attenuation in the surface waters during night, it is still not clear what the underlying processes are? For instance, is it due to a direct grazing on the aggregates by the zooplankton, do the zooplankton organics fragment large fast-settling aggregates into small slow-sinking aggregates, or do the zooplankton graze on marine snow and thereby transform it into fecal pellets?

To be able to follow the changes in particle composition both vertically and diurnally, we deployed a drifting array consisting of conventional cylindrical sediment traps, gel traps, and a drifting camera system which captured the particle size-distribution and concentrations at high temporal resolution in a chosen depth (see chapter 3.4.2). The conventional sediment traps are mainly used for biogeochemical analysis to measure the chemical composition of the bulk settling material, e.g. organic particulate carbon, inorganic particulate carbon, silicate, and lithogenic material. All the chemical measurements will be done in the home lab and the samples are fixed with Mercury(II)Chloride and kept cold between collection and sample analysis. The gel traps consist of a cylindrical trap tube in which a little jar filled with a high viscous liquid is inserted. After deployment the gel-jar is removed and the pictures of the collected aggregates and particles are taken at high resolution using a digital camera. The advantage of gel traps over conventional traps is that the gel traps preserve the size, shape and structure of the settling aggregates. Especially marine snow is very fragile and typically break apart once they are collected in a conventional trap. There, it is impossible to determine how the material sank through the water column, i.e. as single cells or in large fast sinking aggregates.

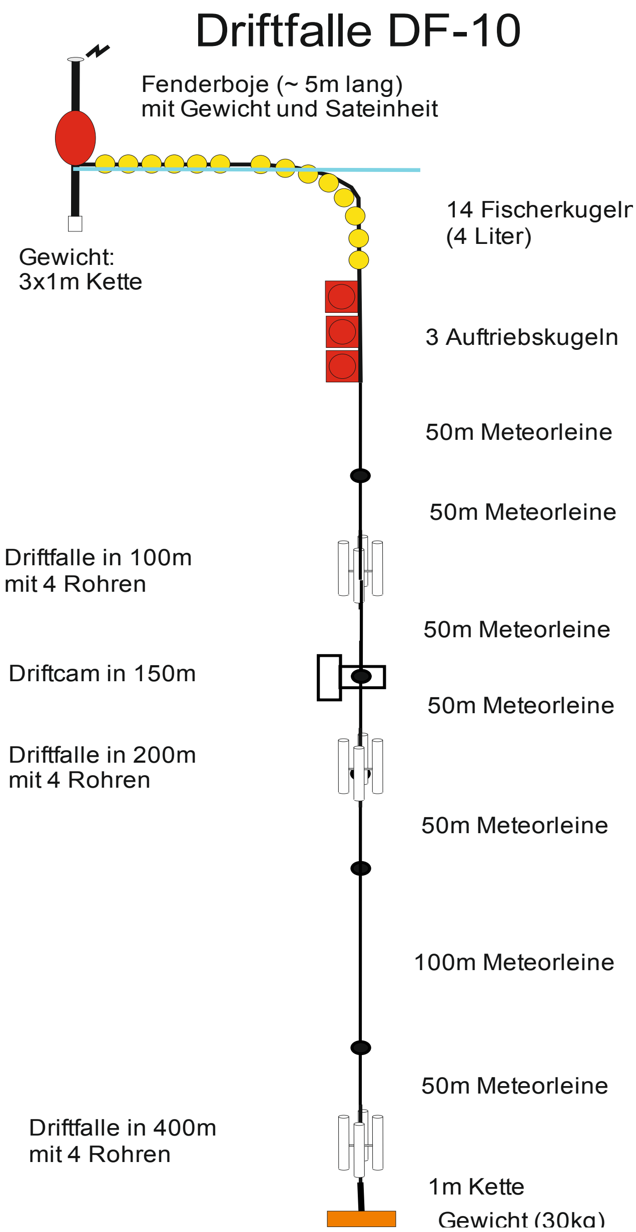


Fig. 3.10 Example of a drifting array (DF-10) deployed close to the Mauritanian coast. Note than the new Driftcam (150m) and three drifting traps in 100, 200 and 400m were deployed. The configuration of Driftcam and traps was slightly different during the cruise (see Table 9).

Our deployments consisted of three sediment traps, each with four sediment trap cylinders of which one was equipped with a gel jar (Fig. 3.10). The three trap depths were 100, 200, and 400 m to follow the vertical changes in particle composition. However, one deployment had collection depths of 150, 200, and 400 m because we placed the drifting cam at 100 m depth (see Table 3.9). Typically two of the trap cylinders without the gel jar were fixed with Mercury(II)Chloride upon recovery and kept cold for biogeochemical analysis. The third trap cylinder without gel jar was either filtered onto a polycarbonate (0.2 µm) filter and frozen for DNA extraction for genetic analysis lateron.

The length of the trap deployment was around 24 hours to be able to capture a whole day/night cycle of export fluxes. We did, however, make one 7 hours deployment during day to be able to see the difference in export fluxes and composition of settling particles between night and day (DF-10, Table 3.9, Fig. 3.10). To follow the primary productivity at the different stations, we deployed 1 l bottles to the trap array. These bottles were deployed in pairs at 7, 14, 21, 31, and 47 m depths. At each depth one dark and one light bottle was deployed. Immediately before the trap deployment, water from the primary production depths was collected using the CTD Rosette system and labelled with carbon 13-bicarbonate and nitrogen 15-nitrate. By filtering the water from each deployed bottle after recovery of the trap array we can determine the incorporation of inorganic carbon and nitrogen into particulate organic matter via primary production and, thus, determine the integrated primary production rates for the different stations.

Table 3.9 Overview of deployment and recovery dates for the four drifting sediment trap deployments DF-7 to DF-10.

Trap name/ GeoB no.	Deployment/ Recovery	Lat N	Long W	Time UTC	Equipment
DF-7:					
18007-1	06.02.14	21°15.67’	20°49.89’	11:07	Driftcam in 100m
19002-4	07.02.14	21°14.36’	20°48.26’	10:29	Traps in 150, 200, 400m Primary production
DF-8:					
18004-5	08.02.14	20°55.58’	19°25.89’	14:34	Driftcam in 150m
18005-4	09.02.14	20°54.95’	19°25.55’	13.06	Traps in 100, 200, 400m Primary production
DF-9:					
18006-9	11.02.14	20°47.97’	18°44.49’	13:30	Driftcam in 250m
18008-1	12.02.14	20°45.09’	18°47.56’	08:59	Traps in 100, 200, 400m
DF-10:					
18011-6	14.02.14	20°37.05’	17°59.22’	11:16	Driftcam in 150m
18011-8	14.02.14	20°35.05’	17°59.57’	18:21	Traps in 100, 200, 400m Primary production

Preliminary Results

The arrays drifted only a few miles, generally to the south or southwest (Table 3.9). A first glimpse into the material collected in the gel traps revealed a shift from a dominance of copepod fecal pellets at the most off-shore stations to a dominance of marine snow aggregates at the station closest to the shore (Fig. 3.11).

These observations reflect the general trend of higher productivity near the shore due to high upwelling of nutrient rich waters. As the phytoplankton grow at high rate they exhaust the nutrients in the upwelled waters and by the time the water has advected to the furthest off-shore stations, there is little phytoplankton growth and therefore only few marine snow aggregates. However, this hypothesis to why there was an increase in the dominance of marine snow near the shore cannot be tested until we have measured the samples incubated for primary production rates.

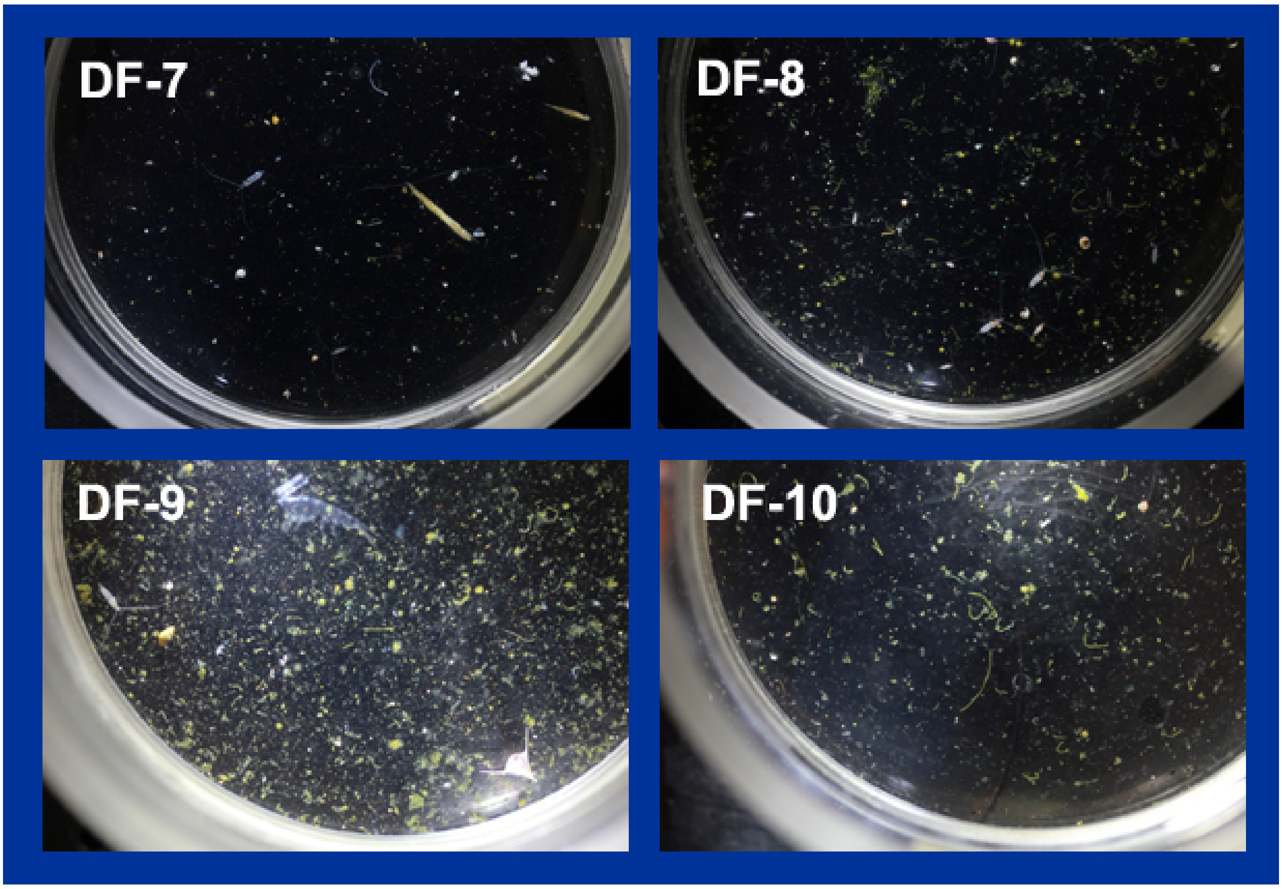


Fig. 3.11 Images from the gel traps deployed at 100 m depth for the four stations. DF-7 was the station furthest off-shore and DF-9 and DF-10 was the station closest to the shore. DF-10 was only deployed during 7 hours (see Table 3.9) but collected quite a significant amount of material. The scale bar showed in the upper left panel is 1 cm long and representative for all four panels.

3.6.2 Seasonal particle fluxes measured with moored sediment traps

(Götz Ruhland, Klaus Dehning, Gerhard Fischer, Nico Nowald and Marco Klann)

Meanwhile, we have an almost complete mass flux record from the mesotrophic study site CB starting in 1988 and from the eutrophic site CBi from 2003 onwards. Both sites are situated within the 'giant Cape Blanc filament (Van Camp et al., 1991) and were designed to monitor the long term (intradecadal to decadal) flux variability as well as potential trends in fluxes due to some climatic forcing or anthropogenic issues (e.g. 'Bakun coastal upwelling intensification hypothesis', Bakun, 1990). It was planned to recover the mooring CB-24 at the beginning of the cruise and deploy it again as CB-25 later on. The mooring position is located about 210 nm off Cape Blanc, Mauritania. Another mooring named CBi-11 was deployed during Poseidon POS-445 cruise around 120 nm further to the east and was also planned to be exchanged to CBi-12). The data of deployments and recoveries of the moorings are listed in Table 10 alongside with the sampling data of the traps.

Table 3.10 Data for recoveries and redeployments of the particle trap mooring arrays.

Mooring	Position	Water depth (m)	Time interval	Instrument	Instr. depth (m)	Intervals (no x days)
Mooring recoveries:						
Cape Blanc mesotrophic:						recovered
CB-24	21°16,8' N	4160	24.01.13–	SMT 243 NE	1214	1 x 26d, 16 x 21d, 1 x 15d
	20°50.5' W		25.03.14	SMT 243 NE	3622	1 x 377d
Cape Blanc eutrophic:						
CBi-11	20°46.4' N	2800	29.01.13–	MSD platform	1299	
	18°44.3' W		25.03.14	SMT 234 NE	1406	17 x 21d, 1x 20d
				SMT 234 NE	1963	17 x 21d, 1x 20d
Mooring deployments:						
Cape Blanc mesotrophic:						programmed
CB-25	21°17.782' N	4160	07.02.14–	SMT 243 NE	1214	20 x 19.5d
	20°50.561' W		04.03.15	SMT 234 NE	3622	20 x 19.5d
Cape Blanc eutrophic:						
CBi-12	20°46.4' N	2750		MSP	1249	
	18°44.5' W		14.02.14–	SMT 234 NE	1356	1 x 12,5, 19 x 19.5d
			04.03.15	SMT 234 NE	1913	1 x 12.5, 19 x 19,5d

Instruments used:
SMT234 NE = particle trap, KUM, Kiel
SMT243 NE = particle trap (Titanium), KUM, Kiel
MSP = multi-sensor platform with FSI-CTD and video camera

After the transit from Las Palmas, the mooring CB-24 app. 210 nm off Cape Blanc was successfully recovered in the afternoon of February 5th, 2014. It was planned to recover the moorings approximately in March 2014. The upper installed particle trap had worked perfectly but due to the early cruise the sample set has not been completed. Therefore, the trap delivered a set of 18 samples. The lower trap delivered only one sample due to a malfunction (stop at cup #1). The mooring was redeployed as CB-25 with a similar configuration in the afternoon of the next day (February 6th, 2014) (Fig. 3.12). In the morning of February 10th, 2014, the ca.

1500 m long mooring array CBi-11 has been released in the coastal part of the Cape Blanc filament. This mooring was equipped with two particle traps each equipped with a sampling carussel of twenty bottles. Additionally a so-called Multi-Sensor Platform (MSP) was moored which was equipped with a video camera to record sequences of sinking particles and a CTD to monitor oceanographic parameters at the same time. Two complete sets of samples of CBi-11 could be retrieved, each with 18 samples due to the programming schedule of the traps (see above). The video camera had recorded a complete set of video sequences, the CTD logged a complete data set until February 10th, 2014. In the early morning of February 13th, the mooring array CBi-12 could be redeployed with a comparable set of devices (Fig. 3.12). Only the installed CTD has been removed due to a failure in the programming procedure. It is planned to recover and redeploy these moorings with RV POSEIDON 481 in winter 2015.

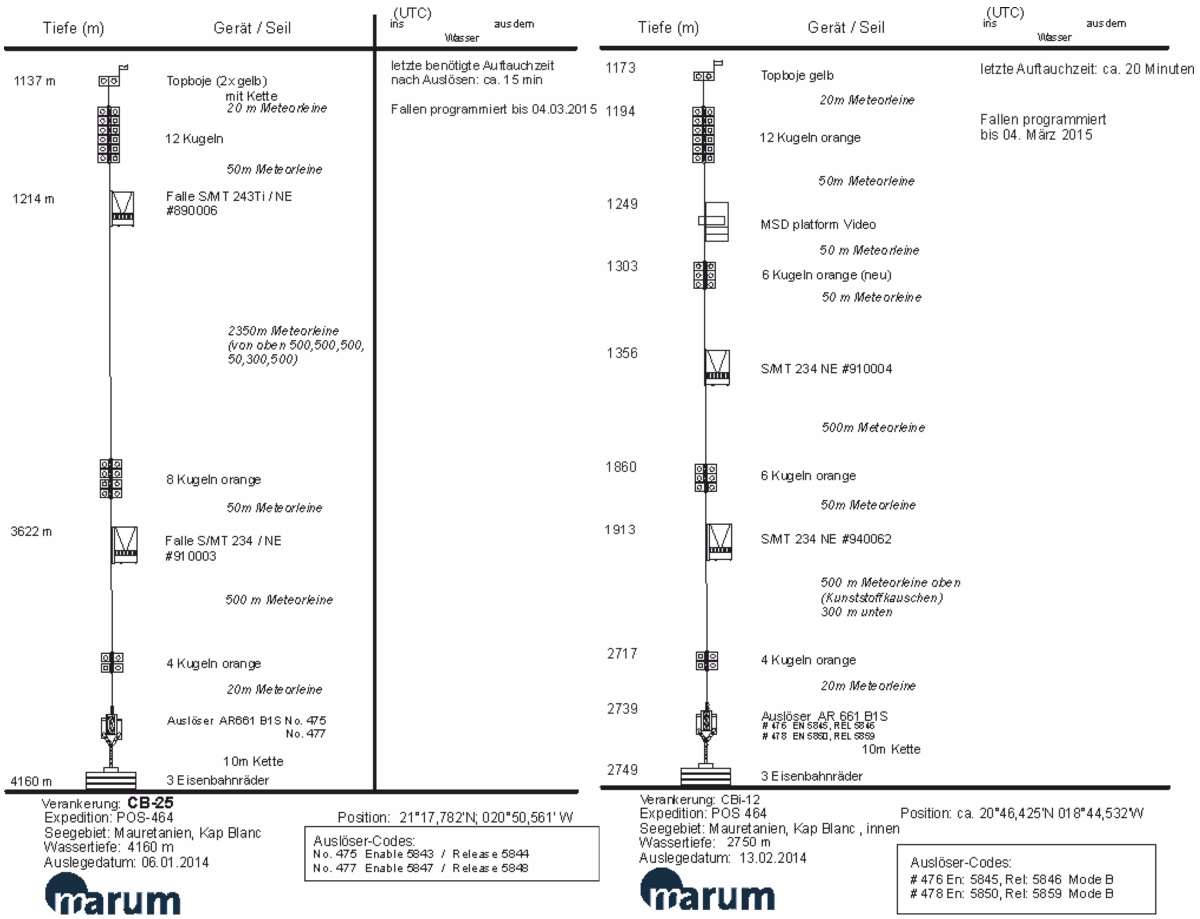


Fig. 3.12 Drawings of the mooring array CB-25 (mesotrophic) and CBi-12 (eutrophic, with MSP) deployed during the cruise.

4 Station List

GeoB#	Ships Stat. No	Date 2014	Device	Time at seafloor/ max. wire length [UTC]	Latitude N	Longitude W	Water depth [m]	Recovery/Remarks
18001-1	9/1	05.02.	CB-24	15:15	21°16.86’	20°55.57’	4160	Release and recovery of sediment trap mooring upper trap ok (#18), lower #1 bulk sample
18001-2			Secchi Disk	15:30	21°16.85’	20°51.23’	4170	Lower down to 17-18m
18001-3	9/2		ROS – CTD	19:34	21°17,89’	20°50,07’	4172	Down to 1000: water from 1000, 600, 400, 200, 130, 75, 30m
18001-4	9/3		ParCa-CTD + Driftcam	21:23	21°17.88’	20°49.96’	4120	With Driftcam attached, down to 450m
18001-5	9/3		ISP (4x)	22:41	21°17,87’	20°49,98’	4167	Down to 1000m: pumping in 1000, 400, 150, 30m
18001-6	9/5	06.02.	ROS-CTD	08:13	21°17,89’	20°50,07’	4172	Down to 100m, water: 100, 47, 31, 21, 14, 7m, PP for DF-7
18001-7	9/6		DF-7	11:07	21°15.67’	20°49.89’	4160	Deployment: Driftcam in 100m, 3 traps in 150, 200, 400m, PP bottles for DF-7 (7, 14, 21, 31, 47m)
18001-8	9/7		Secchi Disk	12:01	21°15.79’	20°50.26’	4164	Lower down to 18m
18001-9	10/1		CB-25	17:37	21°17,78’	20°50,56’	4160	Deployment with 2 sediment traps
18001-10	10/2		ParCa-CTD	20:10	21°17.19’	20°51.22’	4214	Down to 500m, 5m interval
18001-11	10/3		MN	21:16	21°17.19’	20°51.18’	4173	Down to 1000m: 1000-600, 600-300, 300-150, 150-80, 80-0m
18002-1	10/4	07.02.	ParCa-CTD	08:41	21°14.34’	20°48.31’	4173	Down to 158m
18002-2	10/5		ParCa-CTD	08:51	21°14.29’	20°48.24’	4149	Down to 87m, problems
18002-3	10/6		ROS-CTD	09:34	21°14.21’	20°48.11’	4155	Down to 500m, water in 400, 200, 150, 95, 30m
18002-4	10/7		DF-7	10:29	21°14.36’	20°48.26’	4167	Start recovery of array
18003-1	11/1	07.02.	ROS-CTD	19:27	21°00.00’	19°50.00’	3705	Down to 500m, no water samples taken
18003-2			ParCa-CTD	20:21	20°59.99’	19°50.00’	3786	Down to 500m
18004-1	12/1	08.02.	ParCa-CTD	08:20	20°55.00’	19°25.05’	3794	Down to 500m
18004-2	12/2		ROS-CTD	09:02	20°54.98’	19°25.01’	3454	Down to 500m, water: 125, 75, 47, 31, 21, 14, 7m, PP for DF-8
18004-3	12/3		MN	10:19	20°55.01’	19°25.01’	3454	Down to 1000m: 1000-600, 600-300, 300-150, 150-80, 80-0m
18004-4	12/4		Secchi Disk	12:00	20°55.00’	19°25.01’	3209	Lower down to 15-16m
18004-5	12/5		DF-8	14:34	20°55.58’	19°25.89’	3488	Deployment of Driftcam in 150m, 3 traps in 100, 200, 400m
18004-6	12/6		ROS-CTD	18:32	20°54.89’	19°25.07’	3541	Down to 500m, no water samples taken
18004-7	12/7		MN	19:47	20°55.02’	19°25.02’	3475	Down to 1000m: 1000-600, 600-300, 300-150, 150-80, 80-0m
18004-8	12/8		ParCa-CTD	21:01	20°55.00’	19°24.99’	3459	Down to 500m
18004-9	12/9		ISP (4x)	21:53	20°54.98’	19°24.97’	3459	Down to 1010m: pumping in 1000, 400, 150, 40m
18005-1	12/10	09.02.	ParCa-CTD	08:35	20°55.95’	19°25.52’	3473	Down to 500m
18005-2	12/11		ROS-CTD	10:18	20°55.90’	19°25.60’	3456	Down to 1000m, water: 400,200,100m
18005-3	12/12		Secchi Disk	12.02	20°55.46’	19°25.95’	3479	Lower down to 14-16m
18005-4	12/13		DF-8	13:06	20°54.95’	19°25.55’	3486	Start recovery of array
18006-1	13/1	10.02.	Driftcam	06:19	20°45.80’	18°44.83’	2771	Down to 120m for 3 hours (ca. 6:10-9:00)
18006-2	13/2		CBi-11	09.30	20°46.40’	18°44.37’	2800	Recovery of mooring array, gel test on trap, upper and lower #18 (ok)
18006-3	13/3		Secchi Disk	12:01	20°47.75’	18°44.23’	2703	Lower down to 13-14m
18006-4	13/4		ROS-CTD	13:33	20°48.08’	18°44.46’	2721	Down to 1000m, no water samples taken
18006-5	13/5		ParCa-CTD	14:52	20°48.05’	18°44.43’	2713	Down to 1000m (day)
18006-6	13/6		ParCa-CTD	21:42	20°48.09’	18°44.57’	2711	Down to 1000m (night)
18006-7	13/7		ISP (4x)	22:18	20°48.12’	18°44.59’	2709	Down to 1000m, pumps in 1000, 400, 150, 30m
18006-8	13/8	11.02.	ROS-CTD	08:30	20°48.05’	18°44.76’	2721	Down to 1000m, water: 400, 200, 100, 60, 50, 40, 20m
18006-9	13/9		DF-9	13:30	20°47.97’	18°44,49’	2708	Deployment of Driftcam in 250m, 3 traps in 100, 200, 400m
18007-1	14/1	11.02.	ROS-CTD	20:25	20°42,06’	18°23.02’	1517	Down to 1000m, water: 120, 50m
18007-2	14/2		HN	21:15	20°42.27’	18°23.02’	1526	Down to 50m, 75µm
18007-3	14/3		HN	21:23	20°42.33’	18°23.06’	1521	Down to 50m, 75µm
18007-4	14/4		ParCa-CTD	22:10	20°42.52’	18°23.09’	1547	Down to 1000m
18008-1	15/1	12.02.	DF-9	08:59	20°45.69’	18°47.56’	2858	Start recovery of array, no satfix anymore
18008-2	15/2		ParCa-CTD	10:23	20°45.90’	18°47.54’	2864	Down to 1000m
18008-3	15/3		ROS-CTD	12:29	20°46.08’	18°47.37’	2823	Down to 1000m: water: 400, 200, 100m

GeoB#	Ships Stat. No	Date 2014	Device	Time at seafloor/ max. wire length [UTC]	Latitude N	Longitude W	Water depth [m]	Recovery/Remarks
18009-1	16/1	12.02.	ROS-CTD	20:36	20°50.79'	19°05.03'	3272	Down to 1000m, no water samples taken
18009-2	16/2		HN	21:10	20°50.79'	19°05.04'	3290	Down to 50m, 75 µm
18009-3	16/3		Driftcam	21:31	20°50.77'	19°05.10'	3280	Test, down to 100m
18009-4	16/4		ParCa-CTD	22:13	20°50.96'	19°05.02'	3254	Down to 250m (stopped)
18010-1	17/1	13.02.	CBi-12	10:18	20°46.43'	18°44.53'	2770	Deployment of two sediment traps and MSP
18010-2	17/2		MN	11:04	20°46.59'	18°44.32'	2736	Down to 1000m: 1000-600, 600-300, 300-150, 150-80, 80-0m
18011-1	18/1	13.02.	Driftcam	18:24	20°37.01'	17°59.29'	750	Down to 100m for 12 hours (18.00-06:00)
18011-2	18/2	14.02.	ROS-CTD	06:37	20°36.99'	17°59.28'	750	Down to 1000m, water: 400, 200, 100, 47, 31, 21, 14, 7m; PP for DF-10
18011-3	18/3	14.02.	ParCa-CTD	07:36	20°37.04'	17°59.32'	749	Down to 207m
18011-4	18/4		ParCa-CTD	08:31	20°37.02'	17°59.35'	750	Down to 700m
18011-5	18/5		MN	09.24	20°37.01'	17°59.33'	747	Down to 700m: 700-600, 600-300, 300-150, 150-80, 80-0m
18011-6	18/6		DF-10	11:16	20°37.05'	17°59.22'	747	Deployment of Driftcam in 150, 3 traps in 100, 200 and 400m, PP bottles for DF-10 (7, 14, 21, 31, 47m)
18011-7	18/7	14.02.	Secchi Disk	12:06	20°36.84'	17°59.27'	744	Lower down to 11-12m
18011-8	18/8		DF-10	18:21	20°35.05'	17°59.57'	757	Start recovery of array
18011-9	18/9		MN	20:21	20°35.07'	17°59.59'	753	Down to700m: 700-600, 600-300, 300-150, 150-80, 80-0m
18011-10	18/10		HN	20:52	20°35.04'	17°59.47'	750	Down to 50m
18011-11	18/11		ParCa-CTD	21:27	20°35.04'	17°59.49'	753	Down to 710m (stopped)
18011-12	18/12		ParCa-CTD	22:16	20°35.05'	17°59.57'	749	Down to 710m
18011-13	18/13	14.02./ 15.02.	ISP (4x)	22:57	20°35.05'	17°59.37'	748	Down to 410, pumps in 400, 200, 100, 30m

Instruments:

CB-24/25: mesotrophic sediment trap mooring off Cape Blanc, Mauritania
CBi-11/12: eutrophic sediment trap mooring off Cape Blanc, Mauritania
DF-7, 8, 9, 10: Drifting trap, each with 3 traps and one Driftcam in different depths in the epi- and mesopelagic
ROS-CTD: Multi-water sampler (rosette) with 12 x 10l bottles and CTD-SBE 5 (Geomar)
PARCA-CTD: Particle Camera System with CTD-SBE 19 (No. 2069) inside the frame (CTD-O_2- chlorophyll-fluorescence-turbidity)
ISP: *in situ*-pumps (4 at maximum)
MN: multinet (5 depth ranges) with 200µm mesh size, standard depths
HN: handnet (75µm), lowered down to 50m
Driftcam: camera system, mainly for drifting arrays

Abbr.:

PP Primary Production

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